

Remarks

I. Claim Amendments

Claims 1-25 are pending in this application. With this Response, claims 1-25 are canceled; and claims 26-78 are newly added. Support for these amendments is shown throughout the specification. No new matter has been added by these amendments.

II. Indefiniteness Rejection

Claims 16-23 and 25 stand rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The terms "said beta-diketonates being the same", "the beta-diketonates are the same", and "the beta-diketonate is the same" is considered unclear in claims 16, 23 and 25 because only one beta-diketonate is recited in claims 1 and 16, and claim 25 does not recite the 'MA₂N_x' formula.

Newly added claim 26 is directed to an *isolated* compound of the formula 'MA₂N_x', where A represents a beta-diketonate, and newly added claim 44 is directed to a liquid *consisting essentially of* a compound of the formula 'MA₂N_x'. Such language excludes the possible presence of a second compound of the formula 'MA₂N_x'; however, it does not preclude the two beta-diketonates of the 'MA₂N_x' compound from being the same or different. Dependent claims 31, 51, and 65 are added to clarify this point.

The phrase "alkaline earth metal or metals" found in claim 18 is considered indefinite because claims 16 (from which claim 18 depends) excludes the presence of more than one compound of the formula 'MA₂N_x' in the liquid. The newly presented claims do not contain the language objected to in the most recent Office Action.

For the above-stated reasons, it is submitted that the pending claims are definite. It is respectfully requested that the rejection be withdrawn.

III. Rejection for Lack of Written Description

Claims 2, (7-11)/2, 13 and 16-22 stand rejected under 35 U.S.C. § 112, first paragraph, as failing to comply with the written description requirement.

The Office Action alleges that there is no support for compounds that are liquids both at 20°C and 60°C, as is required by claim 2 (and newly added claim 27). Applicants respectfully disagree. Firstly, originally filed claim 2 is considered to be self-supporting. Secondly, all the compounds described in the specification for which viscosity data are provided are liquids at 20°C. This statement is supported by the Declaration of Roy G. Gordon, which accompanies this Response. Because compounds that are liquid at both 20°C and 60°C are described in the specification, Applicants submit that the written description requirements of the Patent Statute are satisfied.

The Office Action also alleges that there is no support for contacting a liquid consisting essentially of the amine-adducted alkaline earth metal beta-diketonate with the substrate, as is recited in claim 16. Newly added claim 44 recites “vaporizing the liquid; and contacting the vapor with a heated surface,” which finds ample support throughout the specification. See, for example, page 8, lines 11-29.

The Office Action further alleges that there is no support for forming more than one metal compound by contacting a liquid consisting essentially of an amine-adducted alkaline earth metal beta-diketonate. Newly added claims 44-57, directed to contacting a liquid consisting essentially of an amine-adducted alkaline earth metal beta-diketonate, do not recite the formation of one or more metal oxides, thereby obviating the rejection.

For the foregoing reasons, newly presented claims 26-78 comply with the written description requirements of the Patent Statute. The rejection may now be withdrawn.

IV. Priority Claim

The Office Action states that claims 1-25 are not entitled to the filing date of priority document U.S.S.N. 60/105,158 (“the ‘158 priority document”) because the provisional application fails to provide support for the full scope of claim 1, 16 24 and 25. See, Office Action dated May 18, 2004, at page 10. Applicants strongly disagree with this assertion as it relates to the pending claims.

The priority ‘158 priority document discloses a compound having the formula MA_2N_x , (page 5, lines 18-23), where x is 1 or 2 (page 6, lines 22-25). The specific formulae for the A (a beta-diketonate) and N (an amine ligand) are described in claims 2 and 6 of the ‘158 priority document, respectively, and elsewhere in the specification, e.g., pp. 5-8 and 18. Compounds having “t greater than or equal to 3” or “at least one of of R^a , R^b , R^c , R^d and R^e contain[ing] two or more carbons” are described in Tables 3 and 4 of the ‘158 priority document. Furthermore, the ‘158 priority document provides detailed chemical reactions schemes for the synthesis of any desired MA_2N_x compound. Over 75 actual examples are reported using barium, calcium and strontium as the alkaline earth metal, and many different combinations of beta-diketonates and amine ligands. The ‘158 priority document also provides a detailed description of the deposition of alkaline earth metal films and mixed metal oxide films using the MA_2N_x compound (p. 7), as well as actual examples of the method (Examples 73-75).

Applicants submit that the full scope of independent claims 26, 44, 58 and 75 is described in the ‘158 priority document and request that the above-identified application be granted the benefit of its filing date of October 21, 1998. Should the Office disagree, Applicants request

specific detailed explanation of the feature or scope of the claims that the Office considers lacks support in the '158 priority document.

V. Rejection of the claims over Baum et al.

Claims 1-9, 14-15 and 23-25 stand rejected under 35 U.S.C. § 102(e) as being anticipated by Baum et al. (U.S. Patent No. 5,919, 522). Applicants traverse this rejection as it applies to the pending claims.

Baum et al. disclose that metal beta-diketonate polyamine adducts form stable adducts that vaporize at lower temperatures, making them useful in metal-organic chemical vapor deposition ("MOCVD") processes (col. 6, lines 22-32). However, Baum et al. do not teach or suggest a compound that is liquid at 60°C. Although Baum et al. make passing reference to a "liquid reagent" (col. 8, l. 29), there is no disclosure of the chemical composition or structure of that reagent or how to identify a reagent having a liquid form.

Baum et al. disclose the compound Ba(thd)₂(pmdeta) (col. 12, l. 19), which the Office Action suggests "is very similar to Applicant's particularly claimed compound Ba(thd)₂(pedeta) (the only difference being that the five methyl groups of pmdeta are replaced with ethyl groups.)" Office Action dated May 18, 2004 at page 4.

Contrary to the suggestion made in the Office Action, the difference between the prior art and the claimed invention is quite significant. The prior art compound, Ba(thd)₂(pmdeta), has $t = 0$ and $R^a = R^b = R^c = R^d = R^e = \text{methyl}$ and is a solid at room temperature.¹ In contrast, Ba(thd)₂(pedeta) has $t = 5$ and $R^a = R^b = R^c = R^d = R^e = \text{ethyl}$, and is a liquid at both 60° and 20°C.

¹ Exhibit 1 is a copy of "Mononuclear Barium Diketonate Polyamine Adducts. Synthesis, Structures and Use in MOCVD of Barium Titanate," (Gardiner et al., *Chem Mater.* **1994** (6), 1967 (1994)), which establishes that Ba(thd)₂(pmdeta) is a solid subliming at 120-150°C at 50 mtorr.

Thus, Baum et al. does not teach or suggest a compound of the formula MA_2N_x that is “a liquid at 60°C” and has “t greater than or equal to 3” as is recited in claims 26, 44 and 58, or “at least one of R^a , R^b , R^c , R^d and R^e contain[ing] two or more carbons,” as is recited in claim 75.

As regards to claims 27 and 34-41, 47, 50-57, 62-71 and 76-78, none of the specific features recited in these claims are disclosed in Baum et al.

For the foregoing reason, Baum et al. does not teach or suggest the invention recited in claim 26, 44, 58 and 75 and those dependent thereon. The rejection may be withdrawn.

VI. Rejection of the claims over Gordon et al.

Claims 1-11, 13-14 and 23-25 stand rejected under 35 U.S.C. § 102(a) as being anticipated by Gordon et al. in a 1999 publication of the Proceedings of the Electrochemical Society (“Proceedings”).

As noted above, the pending claims find full support in the ‘158 priority document having a filing date of October 21, 1998. The Proceedings therefore is not prior art to the claimed invention, and the rejection may be withdrawn.

VII. Rejection of the claims over Baum et al. in view of Hintermaier et al.

Claims 1-9, 14-19 and 22-25 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Baum et al. in view of Hintermaier et al. (U.S. Patent No. 6,303,391).

Baum et al. is relied upon as described above. The compounds disclosed in Baum et al. are solids and have $t = 0$. Baum et al. do not teach or suggest a compound having the formula MA_2N_x , where N and A have the formulae as set forth in claims 26, 44, 58 and 75 and where t is “greater than or equal to 3” as is recited in claims 26, 44 and 58, or “at least one of R^a , R^b , R^c , R^d and R^e contain[ing] two or more carbons,” as is recited in claim 75.

Hintermaier et al. do not provide this teaching. Hintermaier et al. are relied upon to teach that precursors to mixed metal oxides may be provided from separate sources during MOCVD.

Hintermaier et al. disclose the use of $\text{Sr}(\text{thd})_2(\text{pmdeta})$ as a precursor in the MOCVD deposition of the multimetal oxide strontium barium titanate (col. 4, l. 4-14); however, like its barium counterpart, $\text{Sr}(\text{thd})_2(\text{pmdeta})$ is a solid² and has $t = 0$. Thus, Hintermaier et al. also fail to teach or suggest a compound having the formula MA_2N_x , where N and A have the formulae as set forth in claims 26, 44, 58, and 75 and where t is “greater than or equal to 3” as is recited in claims 26, 44 and 58, or where “at least one of R^a , R^b , R^c , R^d and R^e contain[ing] two or more carbons,” as is recited in claim 75.

Neither reference recognizes or suggests that certain amine adducts of an alkaline earth diketonate reduce the melting point of the compound so that the compound is a liquid at 60°C , let alone that the diketonate and/or the amine ligand should include substituents with a high number of angular variables ($t \geq 3$) or with R^a , R^b , R^c , R^d or R^e having two or more carbons. Thus, the Baum et al. in view of Hintermaier et al. do not render the invention recited in claims 26, 44, 58 or 75 (or those dependent thereon) unpatentable.

VIII. Rejection of the claims over Baum et al. in view of Sandy

Claims 10-13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Baum et al. in view of Sandy (U.S. Patent No. 4,189,306).

Baum et al. is relied upon as described above. Sandy discloses transition metal beta-diketonate adducts with diamines. Sandy discloses a large number of methyl-substituted diamines (for which $t = 0$) (col. 3, l. 54-col. 4, l. 27). Sandy also discloses that one or more methyl groups may be substituted by one or more ethyl, propyl or butyl groups (col. 4, l. 28-31). The desirability of doing so and the consequences (good or bad) of doing so are not addressed.

The Office Action suggests that it would have been obvious to select each of R^a through R^e from the group of hydrogen, methyl, ethyl, propyl and butyl, since Sandy teaches that such

² It has a vapor pressure of 0.1 torr at 240°C .

substitutents are equally operable on amines used as ligands to stabilize volatile transition metal beta-diketonates. Applicants respectfully disagree.

Sandy does not stand for the general proposition that higher alkyl diamines can be used to stabilize metal beta-diketonates. Sandy specifically teaches that higher alkyl diamines can be used to stabilize *hexacoordinated transition metal compounds of Mn, Fe, Co and Ni* (col. 1, l. 1.1) as antiknock additives for hydrocarbon fuels (col. 1, l. 34-35). There is no suggestion in Sandy that such higher alkyl diamines would serve equally to stabilize compound of alkaline earth metals in an MOCVD deposition process. Indeed, there is no reason to expect that to be the case, as alkaline earth metals have different chemistry, oxidation states and coordination numbers than Mn, Fe, Co and Ni.

Significantly, neither Baum et al. nor Sandy teach or suggest alkaline earth metal beta-diketonate amine adducts, in which at least one of the R^a through R^e contain two or more carbons. Sandy notes in a single sentence that higher alkyl-substituted anime complexes of transition metals can be made, but provides no incentive for one to explore this general class of materials further. Even if motivated by Sandy's stated goal to increase the volatility of transition metal beta-diketonate compounds, one would not necessarily increase the size of the R-groups on the amines because higher molecular weight (as can result from a higher alkyl torsion number *t*) often results in reduced volatility.

Lastly, Sandy does not recognize or teach the desirability of a compound that is liquid at 60°C and hence provides no motivation to modify the Baum compounds in order to achieve such a result. Sandy does not teach or suggest to reduce the melting point of a compound by selecting ligand substituents such that *t* is greater than or equal to 3, or at least one of the R^a through R^e contain two or more carbons.

For the foregoing reasons, it is submitted that the teachings of Baum et al. in view of Sandy does not provide the motivation to make a compound of the formula MA_2N_x , “wherein the amine and the beta-diketonate are selected to provide t greater than or equal to 3, where t is a total number of carbon-carbon single bonds that rotate alkyl groups with less symmetry than a methyl or a tert-butyl group,” or “wherein at least one of R^a , R^b , R^c , R^d and R^e contains two or more carbons” as recited in claims 26, 44, 48 or 75. The rejection may be withdrawn.

IX. Rejection of the claims over Baum et al. in view of Hintermaier et al. and further in view of Sandy.

Claims 10-13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Baum et al. in view of Hintermaier et al. and further in view of Sandy.

For the reasons present above in sections VII and VIII, it is submitted that the claims are patentable over the cited references.

X. Rejection of the claims over Baum et al. in view of Hintermaier et al. and further in view of Summerfelt (U.S. Patent No. 5,589,284) and Tong et al. (U.S. Patent No. 5,464,453)

Claims 20-21 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Baum et al. in view of Hintermaier et al. and further in view of Summerfelt et al. and Tong et al.

Baum et al. and Hintermaier et al. are relied upon as previously described and thus fail to teach or disclose a compound of the formula MA_2N_x , “wherein the amine and the beta-diketonate are selected to provide t greater than or equal to 3, where t is a total number of carbon-carbon single bonds that rotate alkyl groups with less symmetry than a methyl or a tert-butyl group,” or “wherein at least one of R^a , R^b , R^c , R^d and R^e contains two or more carbons” as recited in claims 26, 44, 48 and 75.

Summerfelt et al. and Tong et al. are directed to deposition of a barium strontium titanate film and a ruthenium oxide film, respectively. Tong et al. discloses that a ruthenium oxide film

is deposited by sol-gel, spraying or spin coating. Because Baum et al. in combination with Hintermaier et al. do not teach or suggest all the elements of the claimed invention, and because Summerfelt et al. and Tong et al. do not provide the disclosure deficient in the principal references, the combined references do not teach or suggest the claimed invention.

XI. Rejection of the claims over Kirlin et al. in view of Gordon

Claims 1-9, 14-18, 20-21 and 23-25 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kirlin et al. (U.S. Patent No. 5,280,012) in view of Gordon (WO 98/46617).

Kirlin et al. disclose a compound of the formula MA_2X , where M is an alkaline earth metal, A is a beta-diketontate and X is an amine or polyamine (col. 9, l. 4-60). Table VI of Kirlin et al. discloses several Ba(acetylacetonate)(polyamine) compounds, all of which are solids at 60°C and all of which have $t = 0$. Applicants have carefully reviewed Kirlin et al. and found no reference to *liquid* alkaline earth metal beta-diketonate compounds.

As with all of the references cited in the Office Action, Kirlin et al. does not disclose a compound of the formula MA_2N_x that is “a liquid at 60°C” and has “t greater than or equal to 3” as is recited in claims 26, 44 and 58, or “at least one of R^a , R^b , R^c , R^d and R^e contain[ing] two or more carbons,” as is recited in claim 75.

Gordon discloses “metal beta-diketonate mixtures [that are] generally liquids or highly soluble glassy solids at room temperature” (p. 14, l. 13-15). The composition is a “mixture of metal beta-diketonate compounds (p. 7, l. 24). Furthermore, Gordon teaches that “the use of a mixture in which a portion of the metal beta-diketonate compounds contains two or more different types of beta-diketonate ligands promotes the formation of the liquid phase” (p. 8, l. 17-19). Gordon also discloses that additional ligands, such as amines, may be bound to the metal beta-diketonates mixtures (p. 13, l. 21-22).

Thus, Gordon teaches that liquid alkaline earth metal beta-diketonate compositions are obtained when *mixtures* of several beta-diketonate compounds are used. Since a *mixture* of metal beta-diketonate compounds is believed to provide the liquid composition, there is no teaching or suggestion of modifying an *isolated* alkaline earth metal compound so as to obtain a compound that is a liquid at 60°C or 20°C, as is recited in claim 26. Nor is there any teaching or suggestion to use “a liquid consisting essentially of a compound having a formula MA₂N” in depositing an alkaline earth metal containing material, as recited in claim 44, since Gordon teaches the desirability of a *mixture* of compounds of the formula MA₂N.

Furthermore, Kirlin et al. in combination with Gordon do not teach or suggest a compound having the formula set forth in claims 26, 44, 48 and 76, in which “*t* is greater than or equal to 3” or “at least one of R^a, R^b, R^c, R^d and R^e contains two or more carbons.” In fact, all the amine ligands disclosed in Gordon have *t* = 0 and therefore do not contribute to lowering the melting point of the compound.

For the foregoing reasons, Kirlin et al. in view of Gordon do not render the claimed invention obvious and it is respectfully requested that the rejection be withdrawn.

XII. Rejection of the claims over Kirlin et al. in view of Gordon and further in view of Hintermaier et al. or Sandy

Claim 19 and 22 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kirlin et al. in view of Gordon and further in view of Hintermaier et al.

Claims 10-13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Kirlin et al. in view of Gordon and further in view of Sandy.

Kirlin et al. and Gordon have been previously discussed. For the reasons discussed above, Kirlin et al. in view of Gordon fail to teach or suggest the claimed metal beta-diketonate

amine adducts in which the compound is a liquid at 60°C, t is greater than or equal to 3, or at least one of R^a , R^b , R^c , R^d and R^e contains two or more carbons.

Hintermaier et al. has also been previously discussed and is relied upon by the Office to teach that precursors to mixed metal oxides may be provided from separate sources during MOCVD. For the reasons set forth above, Hintermaier et al. fails to teach or suggest the claimed features of the invention.

Sandy teaches that higher alkyl-substituted diamines can be used to stabilize hexacoordinated transition metal compounds of Mn, Fe, Co and Ni. As previously argued, Sandy does not recognize or teach the desirability of a compound that is liquid at 60°C. Sandy also does not teach or suggest to reduce the melting point of a compound by selecting ligand substituents such that t is greater than or equal to 3, or at least one of the R^a through R^e contain two or more carbons.

For the foregoing reasons, Kirlin et al. in view of Gordon and further in view of Hintermaier et al. or Sandy do not render the claimed invention obvious and it is respectfully requested that the rejection be withdrawn.

XIII. Miscellaneous

It is respectfully submitted that the foregoing arguments and amendments put the claims in condition for allowance. A favorable notice is respectfully requested.

The Commissioner is authorized to charge Deposit Account No. 08-0219 for the fee required for the addition of new claims and for any Extension of Time. If there are any charges, or any credits, please apply them to Deposit Account No. 08-0219.

Respectfully submitted,

A handwritten signature in dark ink, appearing to read "Mary Rose Scozzafava", is written over a horizontal line.

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Date: October 18, 2004

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